CLAIMS

1. An electrostatic lens for focusing electrons from a cathode to an anode, comprising:

a first conductive layer having a first opening at a first distance from the cathode, the first conductive layer held at a first voltage; and

a second conductive layer having a second opening at a second distance from the first conductive layer and a third distance to the anode layer, the second conductive layer held at a second voltage substantially equal to the voltage of the anode;

wherein the first opening and the second opening are chosen based on the first voltage, second voltage, first distance, second distance, and third distance to focus the electrons emitted from the cathode onto the anode to a spot size less than 40 nanometers.

2. The electron lens of claim 1 wherein the sum of the second distance and the third distance is within about one times to about two times the first distance.

3. The electron lens of claim 1 wherein the third distance is equal to or less than about 2 micrometers.

4. The electron lens of claim 1 wherein the first and second openings have a diameter about 7.2 micrometers, and the first and second distances are about 5 micrometers.

5. The electron lens of claim 1 wherein the force created between the cathode and the anode is less than about 0.03 Newtons/cm^2.

6. The electron lens of claim 1 wherein the spot size is less than about 10 nanometers.

7. The electron lens of claim 1 wherein the sensitivity to lens and shield geometry due to fabrication process variations is minimized.

8. The electron lens of claim 1 wherein the difference between the first voltage and the second voltage is about 700 volts.

9. The electron lens of claim 1 wherein the first conductive layer and the second conductive layer are formed using semiconductor thin-film technology.

10. The electron lens of claim 1 wherein the cathode layer comprises at least one spindt-tip emitter.

11. The electron lens of claim 1 wherein the cathode comprises at least one flat emitter.

12. A focused electron emitter, comprising:

a emitter layer at a first potential;

a lens layer disposed over a first distance from the emitter layer having a first opening and second potential; and

a shield layer disposed over a second distance from the lens layer having a second opening substantially the same diameter as the first opening and held at a third potential;

wherein a focused electron beam is formed on an anode held at the third potential at a third distance from the shield layer.

13. The focused electron emitter of claim 12 wherein the sum of the second distance and the third distance is between about one to about two times the first distance.

14. The focused electron emitter of claim 12 wherein the emitter layer comprises at least one spindt-tip.

15. The focused electron emitter of claim 12 wherein the emitter layer comprises at least one flat emitter.

16. The focused electron emitter of claim 12 wherein the first distance and the second distance are substantially equal.

17. The focused electron emitter of claim 12 wherein the first distance is about 5 micrometers.

18. The focused electron emitter of claim 12 wherein the first opening and the second opening have substantially the same diameter.

19. The focused electron emitter of claim 12 wherein the diameter of the first opening is about 7.2 micrometers.

20. The focused electron emitter of claim 12 wherein the force created between the emitter layer and the anode layer is less than 0.03 Newtons/cm^2.

21. The focused electron emitter of claim 12 wherein the focused beam creates a focused spot size of less than 40 nanometers on the anode.

22. The focused electron emitter of claim 12 wherein the focused beam creates a focused spot size of less than 10 nanometers on the anode.

23. The focused electron emitter of claim 12 wherein the difference between the first potential and the second potential is greater than 500 volts.

24. The focused electron emitter of claim 12 wherein the third distance is equal to or less than about 2 micrometers.

25. A mass storage device comprising at least one focused electron emitter of claim 12.

26. An electronic device comprising at least one mass storage device of claim 25.

27. A display device comprising at least one focused electron emitter of claim 12.

28. An electronic device comprising at least one display device of claim 25.

29. A field emission device for creating a focused electron beam on an anode, comprising:

a cathode layer having at least one electron emitter;

a focusing lens including,

a lens layer disposed on the cathode layer; and

a shield layer interposed between the lens layer and the anode wherein the electrostatic attraction between the lens layer and the anode is reduced.

30. The field emission device of claim 29 wherein the sum of the distance between the lens layer and the shield layer and the distance between the shield layer and the anode is between about one to about two times the distance between the lens layer and the cathode layer.

31. The field emission device of claim 29 wherein the distance of the lens layer from the cathode layer and the distance of the shield layer from the lens layer are substantially equal.

32. The field emission device of claim 29 wherein distance of the lens layer from the cathode layer is about 5 micrometers.

33. The field emission device of claim 29 wherein lens layer and the shield layer include an opening for creating the focused electron beam, the openings having substantially the same diameter.

34. The field emission device of claim 33 wherein the diameter of the opening in the lens layer is about 7.2 micrometers.

35. The field emission device of claim 29 wherein the force created between the cathode layer and the anode is less than 0.03 Newtons/cm^2.

36. The field emission device of claim 29 wherein the focused electron beam creates a focused spot size of less than 40 nanometers on the anode.

37. The field emission device of claim 29 wherein the focused electron beam creates a focused spot size of less than 10 nanometers on the anode.

38. The field emission device of claim 29 wherein lens layer and the shield layer have a voltage potential difference greater than 500 volts.

39. The field emission device of claim 29 wherein the distance between the shield layer and the anode is equal to or less than about 2 micrometers.

40. A mass storage device comprising at least one field emission device of claim 29.

41. An electronic device comprising at least one mass storage device of claim 40.

42. A display device comprising at least one field emission device of claim 29.

43. An electronic device comprising at least one display device of claim 42.

44. A field emission device for creating a focused electron beam on an anode, comprising:

means for creating a source of electrons;

means for focusing the source of electrons on the anode;

means for shielding the means for focusing from the anode to reduce electrostatic attraction forces, said means for shielding disposed between the means for focusing and the anode.

45. The field emission device of claim 44 wherein the sum of the distance between the means for focusing and the means for shielding and the distance between the means for shielding and the anode is about one to about two times the distance between the means for focusing and the means for creating a source of electrons.

46. The field emission device of claim 44 wherein the distance between the means for creating and the means for focusing and the distance between the means for focusing and the means for shielding are substantially equal.

47. The field emission device of claim 44 wherein the distance between the means for creating and the means for focusing is about 5 micrometers.

48. The field emission device of claim 44 wherein the means for focusing and the means for shielding include a first opening and a second opening having substantially the same diameter.

49. The field emission device of claim 44 wherein the means for focusing includes an opening having a diameter of about 7.2 micrometers.

50. The field emission device of claim 44 wherein the force created between the means for shielding and the means for creating is less than 0.03 Newtons/cm^2.

51. The field emission device of claim 44 wherein the focused beam creates a focused spot size of less than 40 nanometers on the anode.

52. The field emission device of claim 44 wherein the focused beam creates a focused spot size of less than 10 nanometers on the anode.

53. The field emission device of claim 44 wherein the means for focusing has a first potential and the means for shielding has a second potential substantially equal to the potential of the anode, and wherein the difference between the first potential and the second potential is greater than 500 volts.

54. The field emission device of claim 44 wherein the distance between the means for shielding and the anode is equal to or less than about 2 micrometers.

55. A mass storage device comprising at least one field emission device of claim 44.

56. An electronic device comprising at least one mass storage device of claim 55.

57. A display device comprising at least one field emission device of claim 44.

58. An electronic device comprising at least one display device of claim 57.

59. A method of making an electron lens for an electron emitting cathode for focusing an electron beam on an anode, comprising the steps of:

creating a lens layer a first distance from the electron emitting cathode, the lens layer having a first opening substantially centered over the electron emitting cathode; and

creating a shield layer a second distance from the lens layer and a third distance from the anode, the shield layer having a second opening substantially aligned with the first opening.

60. The method of claim 59 wherein the sum of the second distance and the third distance is between about one to about two times the first distance.

61. The method of claim 59 wherein the first distance is substantially equal to the second distance.

62. The method of claim 59 wherein the first distance is about 5 micrometers.

63. The method of claim 59 wherein the third distance is equal to or less than about 2 micrometers.

64. The method of claim 59 wherein the diameter of the first opening is about 7.2 micrometers.

65. A method of making a memory device, comprising the steps of:

creating a cathode layer having at least one electron emitter;

creating a lens layer a first distance from the cathode layer and having a first opening substantially centered over the at least one electron emitter;

creating a shield layer a second distance from the lens layer and having a second opening substantially aligned with the first opening; and

creating an anode layer having a media surface responsive to focused electron energy from the electron emitter, the media surface a third distance less than or equal to about 2 micrometers from the shield layer.

66. A method of making a display device, comprising the steps of:

creating a cathode layer having at least one electron emitter;

creating a lens layer a first distance from the cathode layer and having a first opening substantially centered over the at least one electron emitter;

creating a shield layer a second distance from the lens layer and having a second opening substantially aligned with the first opening; and

creating an anode layer having a phosphorous surface responsive to focused electron energy from the electron emitter, the phosphorous surface a third distance less than or equal to about 2 micrometers from the shield layer.